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GB 0887057 US 4193424

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F2V

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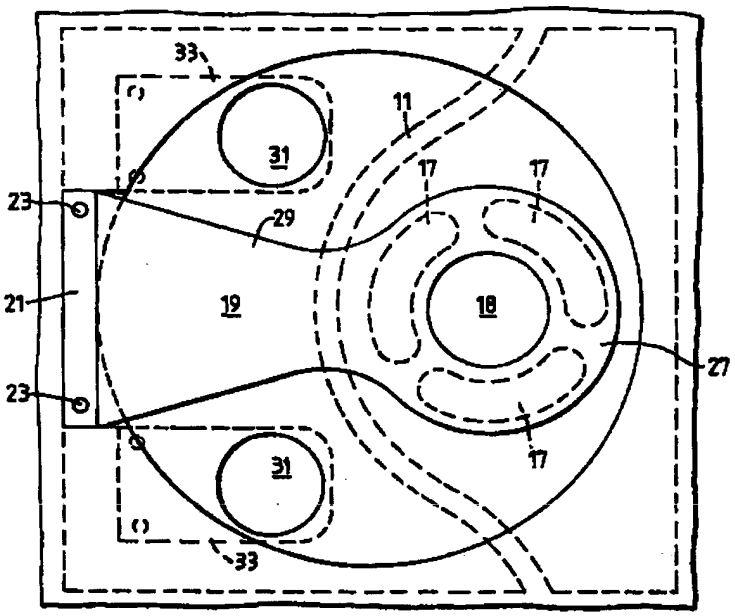
(54) Read valve

(57) A valve, for an inlet or outlet port in a refrigeration compressor, comprises an elongate resilient reed 19, the reed comprising at least one body portion 29 which is fixed at one end 21 to a mount and which, at the other end, is contiguous with a valve closure portion 27 configured for selectively uncovering a port(s) 17 to allow flow of fluid therethrough, wherein the width of the body portion 29 tapers towards the valve closure portion 27 so that the width of the body portion adjacent the valve closure portion is small relative to the width of the valve closure portion wherein the configuration of the reed is such as substantially to equalise the bending stress experienced by the reed along the length of the body portion when a load is applied to the valve closure portion so as to obviate the need for the provision of a stationary obstacle for impeding the movement of the reed in use.

FIG. 3.



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The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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FIG.1.

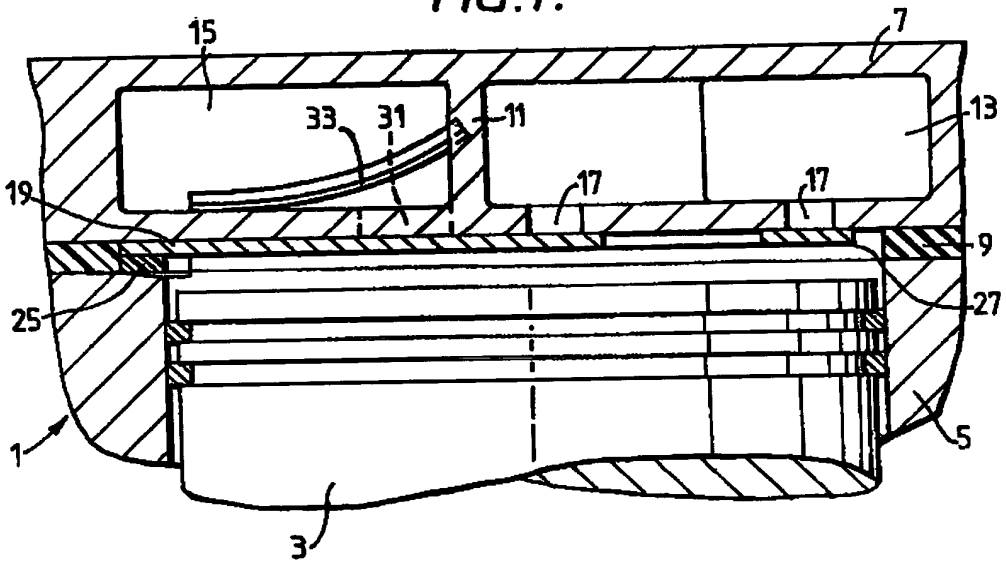
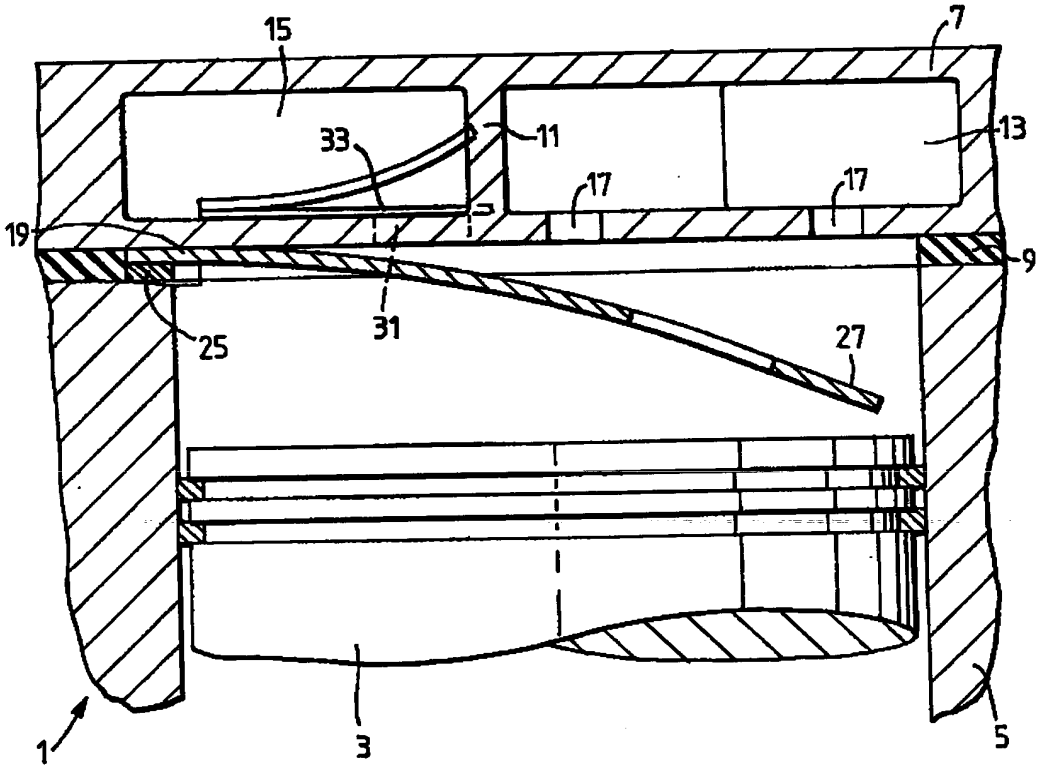

15
7
33
31
11
13
19
17
17
9
25
27
1
5
3

FIG.2.


15
7
33
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13
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19
9
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FIG. 3.

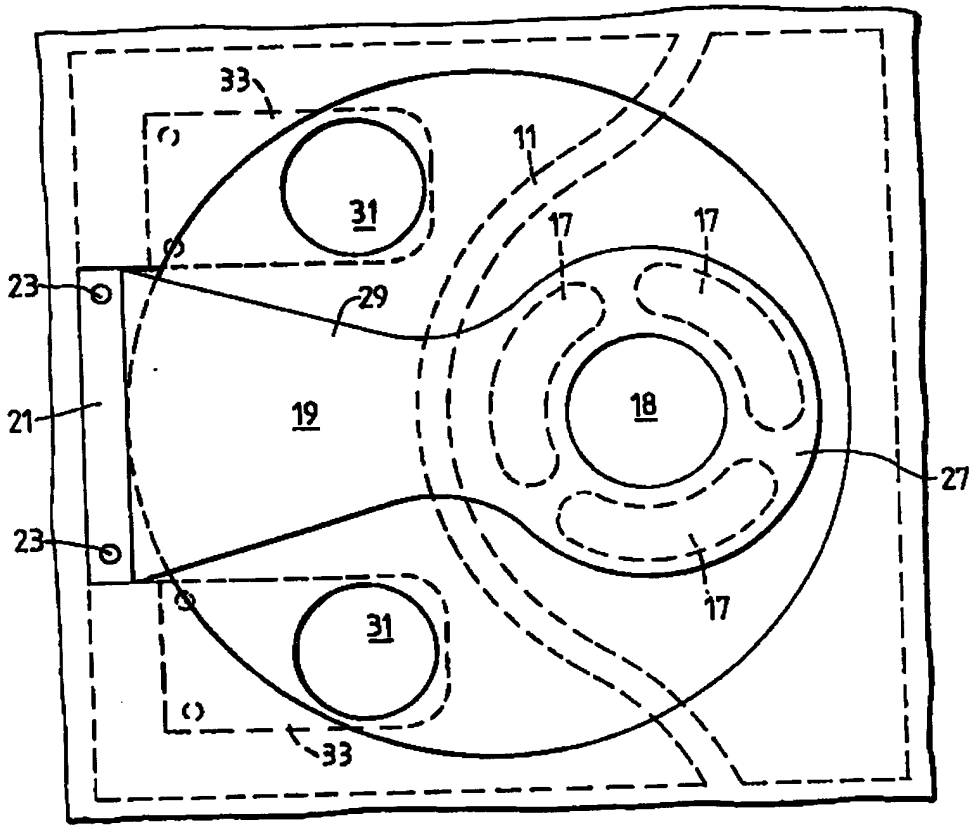


FIG.4.

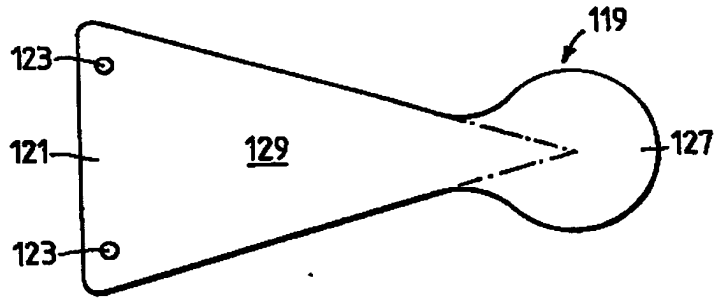
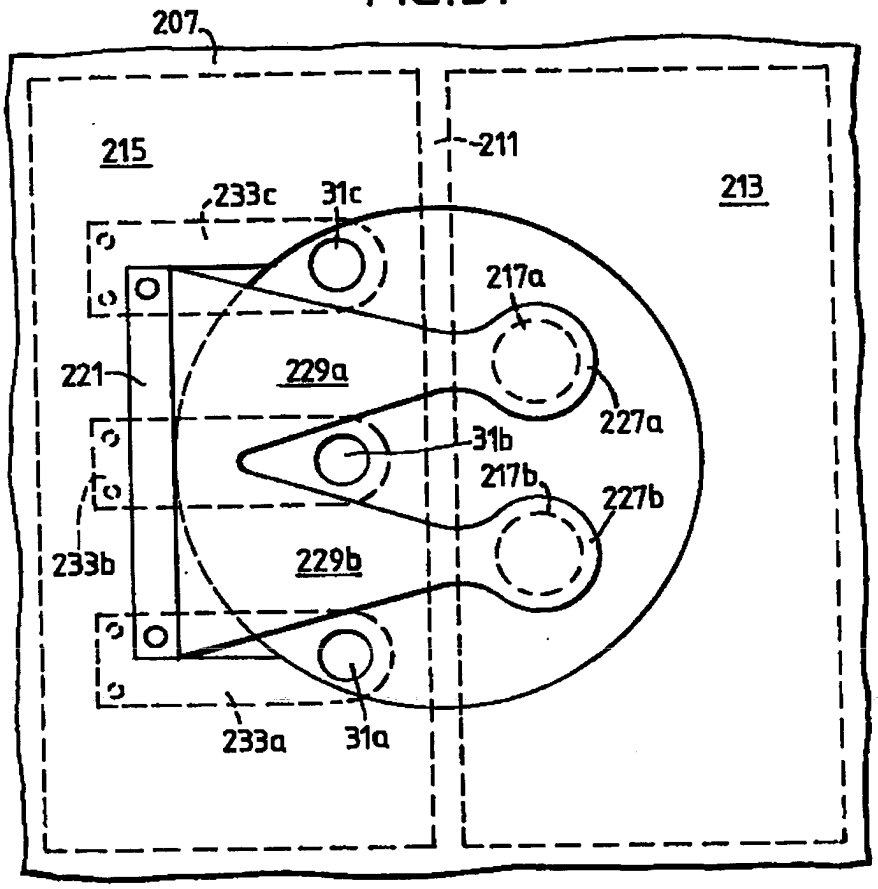

119
123
121
129
127
123

FIG.5.


207
215
211
213
233c
31c
217a
221
229a
227a
31b
217b
227b
233b
229b
233a
31a

SPECIFICATION

Reed valve

This invention relates to a reed valve, for use in a compressor.

A known reciprocating compressor has a cylinder having an inlet valve including a resilient reed which is mounted within the cylinder. The reed moves away from a valve seat to open an inlet port when the piston moves downwardly and the pressure differential between the inlet port and the interior of the cylinder reaches a certain level. The valve reed is held at a first end, which is spaced from the cylinder inlet, the gas flow forcing the reed to move and flex during intake to allow a second end of the reed to uncover the inlet port.

It has been considered undesirable for the known inlet reed to move away from the inlet port by more than a small amount, as a large degree of movement results in excess deformation fatigue and then ultimate failure of the reed. To alleviate this problem the inlet reed is conventionally provided with at least one projection at its second end, which engages with a stationary obstacle or tip-stop in the cylinder wall, the stop limiting movement of the reed to a small degree. Such a reed valve is disclosed in the applicants prior application No. GB 2105821A.

It is a problem with such reeds that the flow through the inlet valve is impaired because the lift of the reed away from the inlet port is limited.

It is a further problem that the reed tip is prone to failure due to cyclical impact of the tip against the tip-stop, which impact also results in added noise.

According to a first aspect of the invention there is provided a cylinder and reciprocating piston assembly having a valve comprising an elongate resilient reed, fixed at one end to a mount and having a valve closure portion for selectively uncovering a port of the cylinder to allow flow of fluid therethrough, said reed being arranged so that movement of the valve closure portion during said flow of fluid is not impeded by a stationary obstacle.

According to a second aspect of the invention there is provided an elongate resilient reed, for a reed valve, having a first end for fixing the reed to a mount and a valve closure portion for controlling flow through a valve port, at least a part of the reed being formed so that load applied to the valve closure portion is absorbed as a substantially uniform bending stress over said part.

According to a third aspect of the invention there is provided a valve assembly for a compressor comprising first and second inlet ports, flow through said ports being controlled by a reed fixed at an end to a mount, the reed including first and second tapered sections tapering away from said end and a discharge port positioned between said tapered sections.

Use of a free-tip suction reed as described below has several advantages. Firstly, as there is no tip-stop, movement of the reed is not impeded during intake of fluid to the cylinder, and thus the lift of the reed is not limited. Also, the noise generated by the interaction of the tip and tip-stop in the prior art is removed, as well as the possible fatigue of the reed caused during use. Furthermore, removal of the projection on the reed for tip-stop engagement results in simplification of reed production, as the reed is of a less complex shape. In the prior art, suction reeds needed to be specially designed to fit across the bore of a particular cylinder whereas, in the present invention, one reed can economically be used on several bore sizes, thus reducing cost.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a compressor cylinder showing a valve reed of the invention in the closed position.

Figure 2 is a view similar to Figure 1 showing the valve reed in an open position.

Figure 3 is an internal plan view of the cylinder head shown in Figure 1.

Figure 4 shows a further embodiment of the reed invention, illustrating the design features.

Figure 5 is an internal plan view of a compressor cylinder head including a further embodiment of the invention.

With reference to Figures 1 to 3 a valve reed of the invention is shown embodied in a compressor 1.

The compressor 1 includes a piston 3 which reciprocates in a cylinder formed from a cylinder block 5 and a cylinder head 7. The cylinder head 7 is attached to the block 5 by means of mounting bolts (not shown) through a gasket 9. The cylinder head 7 is divided by a baffle 11 into an inlet side 13 and a discharge side 15.

The inlet side 13 has an inlet port 17 provided in three part-annular portions (see Figure 3). Flow through the inlet port 17 is controlled by means of a resiliently flexible reed 19. The reed is elongate and is fixed between the cylinder head 7 and block 5 at one end 21 by means of mounting pins 23. In order to accommodate differences in the width between gasket 9 and reed 19, and to ensure a firm connection between the reed 19 and the cylinder, a piece of resilient material 25 is fixed, with the reed 19, to the block 5.

The reed 19 has a tapered portion 29 extending from the fixed end 21, and a valve closure portion 27 connected to the portion 29 for covering the inlet port 17.

The valve closure portion 27 is freely movable away from the port 17 and is of annular shape, in plan, to allow intake fluid entering the cylinder to pass over the outer edge and

through the centre of the valve closure portion 29.

The tapered portion 29 forms part of an isosceles triangle, with the base of the triangle being provided by the fixed end 21 and with the apex of the triangle being defined at a point within the outer circumference of valve closure portion 27, which point is chosen to be the centre of application for the load generated by the fluid which enters the cylinder through the inlet port 17 during intake. This shape of portion 29 allows the reed 19 to bend at a constant radius of curvature and flex to a far greater degree than the known inlet reed discussed above without risk of failure as will be hereinafter described. The width of the fixed end 21 is determined by the stress level which it is desired that the reed will absorb in use.

The discharge side 15 is provided with two outlet ports 31 spaced equally from the centre line of the inlet reed 19. Each discharge port 31 is provided with a discharge reed 33 of conventional construction.

In use, the inlet reed 19, which is generally planar, normally rests against the cylinder head 7 as shown in Figure 1. During a discharge stroke of the piston 3 as illustrated in this figure, the fluid in the cylinder is pushed out through discharge ports 31, the pressure of the fluid within the cylinder serving to seal reed 19 against inlet port 17.

In Figure 2, the piston 3 is shown during an inlet stroke. Downward movement of the piston 3 causes a pressure difference across the inlet reed 19. This causes the reed 19 to flex, against its resilience, away from the port 17 thus allowing intake fluid through the port 17 into the cylinder. As the valve closure portion 27 is freely movable away from the inlet port 17 and no tip-stop is provided, movement of the reed 19 is not impeded.

The major factor which allows the removal of the tip-stop from the design will now be explained with reference to Figure 4 in which an alternative embodiment of a valve reed of the invention, generally designated 119 is shown, the reed 119 being of similar form to reed 19, except that it has a circular valve closure portion for covering a circular inlet port.

As briefly mentioned with reference to the last embodiment, the portion 129 joining the fixed end 121 to the valve closure portion 127, is of tapered shape so that the centre of application of load generated by the inlet fluid, when the valve is open, forms the apex of an isosceles triangle having its base at the fixed end 121.

This particular form of the portion 129 is chosen because it will result in the bending stress of the reed 119, when in the open position due to fluid entering the cylinder under pressure, being equalised over the whole length of the tapered portion, so that no part of this portion is stressed substantially more than any other part during flexure of the reed. This means that the reed can tolerate a large deflection without risking failure.

Using a reed of the above design, it is therefore possible to completely remove the need for a tip-stop as the reed can tolerate considerably greater bending than reeds so far proposed in the prior art.

At high suction pressure conditions the inlet valve may open when the piston has moved only a short distance away from the head 7. The reed at this stage may contact the piston, which advantageously acts as a moving buffer to prevent excessive reed deformation at such high suction pressures.

With reference to Figure 5, a further embodiment of the invention having a dual suction reed 219 is shown. This reed has a single fixed end 221 but has two valve closure portions 227a and 227b which cover respective inlet ports 217a and 217b. The valve closure portions 227a,227b are connected to the fixed end 221 by means of respective tapered portions 229a, 229b, each of similar form to the reed shown in Figure 4.

This design of reed has an advantage that a discharge opening 231b can be provided between the two tapered portions 229a,229b, in addition to discharge openings 231a and 231c, thus allowing increased flow from the cylinder, as well as providing the other advantages of the basic reed design previously mentioned.

Although the invention has been described with reference to an intake valve assembly, it is equally applicable for use with a discharge valve assembly.

The embodiments of reed valve described are particularly, but not exclusively, suitable for use in a refrigeration compressor.

CLAIMS

1. A valve assembly having a valve comprising an elongate resilient reed, the reed comprising a body portion which is fixed at one end to a mount and which, at the other end, is contiguous with a valve closure portion configured for selectively uncovering a port to allow flow of fluid therethrough, wherein the width of the body portion tapers towards the valve closure portion so that the width of the surface of the body portion adjacent the valve closure portion is small relative to the width of the valve closure portion wherein the configuration of the reed is such as substantially to equalise the bending stress experienced by the reed along the length of the body portion when a load is applied to the valve closure portion so as to obviate the need for the provision of a stationary obstacle for impeding the movement of the reed in use.

2. A valve assembly according to claim 1 wherein the body portion provides with a neck adjacent the valve closure portion.

3. A valve assembly according to claim 1 or claim 2 wherein the body portion forms part of an isosceles triangle, the base of the triangle lying at the fixed end of the reed and the apex of the triange lying at a point in the valve closure portion.

4. A valve assembly according to claim 3 wherein said point in the valve closure portion is chosen to be the centre of application for the load generated by the fluid which enters through the inlet port.

5. A valve assembly according to any preceding claim wherein the body portion of the reed comprises first and second tapered sections tapering away from the fixed end of the reed, each of said tapered sections being contiguous with a valve closure portion configured for selectively uncovering first and second inlet ports and wherein a discharge port is positioned between said tapered sections.

6. A valve assembly according to any preceding claim which is an intake valve assembly.

7. A valve assembly according to any preceding claim which is suitable for use in a compressor.

8. A reed for use in a valve assembly according to any preceding claim.

9. A valve system substantially as herein described with reference to and as illustrated in figures 1-3 or figure 4 or figure 5 of the accompanying drawings.

10. A reed substantially as herein described with reference to and as illustrated in figures 1-3 or figure 4 or figure 5 of the accompanying drawings.

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